DOCUMENT RESUME

ED 456 696 HE 034 252

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TITLE	1999 Initial Employment Report: Follow-Up of 1998 Physics and Astronomy Degree Recipients. AIP Report.
INSTITUTION	American Inst. of Physics, College Park, MD. Statistical Research Center.
REPORT NO	AIP-R-282.22
PUB DATE	2001-09-00
NOTE	14p.
PUB TYPE	Information Analyses (070) -- Numerical/Quantitative Data (110)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Astronomy; *College Graduates; *Degrees (Academic); *Employment Patterns; Graduate Surveys; Higher Education; Labor Market; *Physics

ABSTRACT

This report is based on an annual survey of physics degree recipients conducted approximately 6 months after the end of the academic year in which they received their degrees. During the 1997-1998 academic year, there were 1,323 physics Ph.D.s conferred at the 183 departments granting physics doctorates in the United States. Departments reported that a little more than half of the degrees were conferred on U.S. citizens, and 13% of degree recipients were women. For the class of 1997-1998, the proportion of new doctorates who were unemployed and seeking work in the United States was 2%, down from a recent high of 6% for the classes of 1993 and 1994. Although some newer physicists filled industrial sector technical jobs, two-fifths of degree recipients who accepted a temporary postdoctoral appointment and almost three-quarters of those in other temporary positions indicated that a suitable permanent position was not available. In the class of 1997-1998, there were 3,821 physics bachelor's degrees awarded at 753 degree granting physics departments in the United States. The responses of 1,130 of these graduates indicate that about half chose to continue their education at the graduate level, and about half entered directly into the workforce. Industry was by far the largest employer. Findings suggest that the job market for new physics bachelors is very diverse. A little more than half of the recipients of master's degrees entered the workforce, and, as with bachelor's degree recipients, their work activities were diverse. About two-thirds indicated that their positions were moderately or extensively related to the field of physics. (Contains 17 figures.) (SLD)

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STATISTICAL RESEARCH CENTER

By Patrick J. Mulvey
Casey Langer

AIP Pub. Number R-282.22

June 2001

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1999 Initial Employment Report: Follow-Up of 1998 Physics and Astronomy Degree Recipients

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1999 Initial Employment Report: Follow-Up of 1998 Physics and Astronomy Degree Recipients

Highlights

- Physics bachelors are doing well in the high tech job market of the late 1990's. The Class of 1997-98 accepted employment in many areas of the work force with the majority (61%) working in the industrial sector, followed by 13% accepting employment at an elementary or high school. (**Figure 11**)

- The median starting salary for physics bachelors in the class of 1997-98 who accepted employment in the industrial sector was $40,000. This represents an increase of 8% from the previous year and 43% from what was reported for the class of 1994. (**Figure 11**)

- Two-thirds of the employed physics bachelors felt that prior work experience had assisted them in obtaining their current position. Much of this work experience was facilitated through the department in the form of co-ops and internships (see **page 8**)

- Financial support for physics bachelor recipients choosing to enter physics graduate study remains strong, with over 97% reporting that they received TA's, RA's or fellowships. (see **Table 1**)

- The proportion of new physics PhDs accepting permanent positions has remained stable at around 50% for the third consecutive year. As in the past the majority of these positions are in the industrial sector. (see **Figure 2 & 4**)

- The median salary reported by physics PhDs in permanent industrial positions was $62,700. PhDs taking postdocs at a university reported a median salary of $35,000. (see **Figure 6**)

- Less than half of the students exiting their current department with a physics master's degree enrolled in another department, with about a quarter continuing in physics. Master's degree recipients who were foreign citizens were much more likely to continue with further schooling than were US citizens, 72% and 32% respectively. (see **Table 2**)

- Astronomy PhDs were more likely than physics PhDs to take a postdoctoral appointment after receiving their degree, 76% vs. 48% respectively. The median salary for new astronomer and astrophysicist postdocs working at a university was $36,000. (See **Page 12**)

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The current job market for new physics and astronomy degree recipients continues to be very strong. The results of the American Institute of Physics' Initial Employment Survey for the class of 1997-98 show rising starting salaries and low unemployment rates. Degree recipients at all levels are finding themselves well equipped to enter the wide variety of technical and computer related fields that are largely responsible for the continuing robust economy in the US.

The Initial Employment Report is based on an annual survey of physics degree recipients conducted approximately six months after the end of the academic year in which they received their degrees. We asked the 762 physics and 69 astronomy departments to provide a current address for their prior year's graduates at all degree levels (For detailed information on academic enrollments and degrees conferred at US physics and astronomy departments, see the AIP **Enrollments and Degrees Report**).

New Physics PhDs

During the 1997-98 academic year there were 1,323 physics PhDs conferred at the 183 departments granting physics doctorates in the US. Departments reported that a little over half (54%) of the degrees were conferred on US citizens, and 13% of the degree recipients were women. More detailed data on 67% of the PhDs were obtained by either direct response from the degree recipients (28%) or by contacting their thesis advisors (39%). However, the data gathered from advisors were limited to describing the degree recipients' citizenship and employment status. The proportion of US citizens for whom we have post-degree information (72%) is substantially better than for the foreign citizens (59%).

The PhD class of 1998 had a median age of 30 and spent a median of six full-time equivalent years of graduate study to complete their degree. Respondent and departmental data indicate that approximately 6% of the US degree recipients and 20% of the non-US degree recipients accepted initial employment outside the US. The figures that follow represent initial employment outcomes for the bulk of physics PhD recipients who, regardless of their citizenship, remained in the United States.

The unemployment rate is one of several indicators that reflect the dramatic improvement in the job market for new physics PhDs during the second half of the 1990's. For the class of 1997-98, the proportion of new doctorates that were unemployed and seeking work in the US was 2% (**See Figure 1**). This is down from a recent high of 6% for the classes of 1993 and 1994. Another indicator of an improved job market is the amount of time new PhDs spend seeking employment before securing a position. Thirteen percent of the PhD Class of 1998 reported seeking employment for more than six months before securing potentially permanent employment, this compares to 42% of the PhD class of 1992. Much of the job market improvement is a result of the willingness of new physicists to meet the industrial sector's need for technically trained individuals.

Figure 1. Employment status of physics PhDs in the winter following their degree, class of 1997-98.

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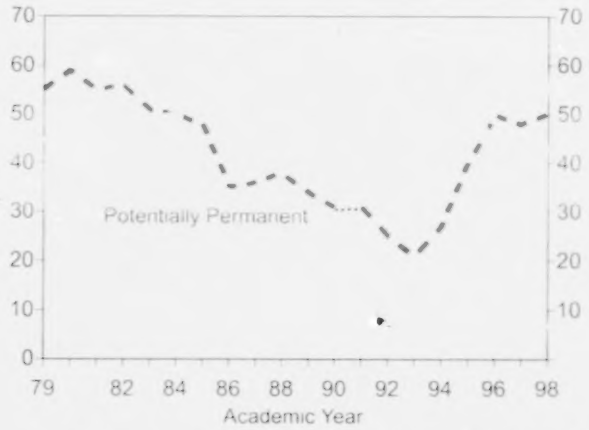
The job market has not necessarily been equally rewarding for everyone. Two-fifths of the degree recipients who accepted a temporary postdoctoral appointment (postdoc) and almost three-quarters of those in other temporary positions indicated they had accepted a temporary position because a suitable permanent position was not available. However, this finding needs to be treated carefully, since it can be interpreted a number of ways. For example, about half of the postdocs who reported that a more suitable permanent position was not available ultimately hoped to get a university faculty position. The traditional prerequisite for obtaining such a position is a postdoc.

This initial employment of these new PhDs reflects a combination of job availability and long-range employment goals of the individual. Among those with potentially permanent positions, plans are understandably more fixed. Thus, 96% of the PhDs already holding permanent positions in academia hoped to remain there for the long term, and only 6% of those with permanent jobs in the industrial sector hoped to switch to the academic sector.

The proportion of new degree recipients accepting potentially permanent positions has stabilized at about 50% (**See Figure 2**). This stabilization comes after more than a decade of declines through the 1980's and early 1990's followed by a three-year period of rapid gains. Helped by the strong economy in recent years, the vast majority of these permanently employed physicists obtained positions in the industrial sector.

The type of initial employment accepted by new PhDs is related, to some extent, to the subfield in which they did their dissertation research (**See Figure 3**). Individuals with dissertation fields such as astronomy, astrophysics and elementary particles tend to accept postdocs upon receiving their degrees. By contrast, a large proportion of PhDs whose subfield was in optics went directly into potentially permanent positions.

Figure 2. Trend data on the type of US employment secured by physics PhDs in the winter following their degree, 1978-1998.



*In 1991, the survey questionnaire was changed to measure "other temporary" employment as a separate category

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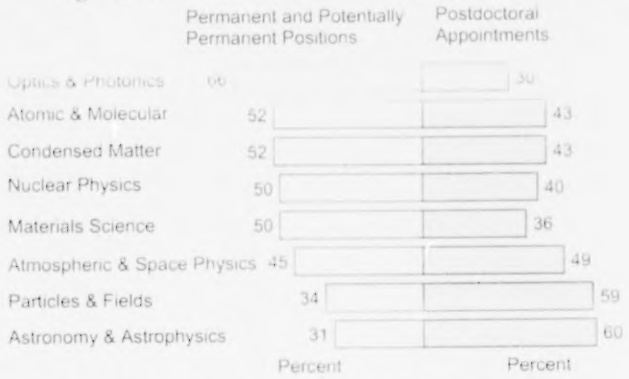
Figure 3. Type of initial employment for US employed physics PhDs by subfield of degree, combined data for classes of 1997 and 1998.



Rows do not add to 100% since they do not include PhDs who accepted other temporary positions.

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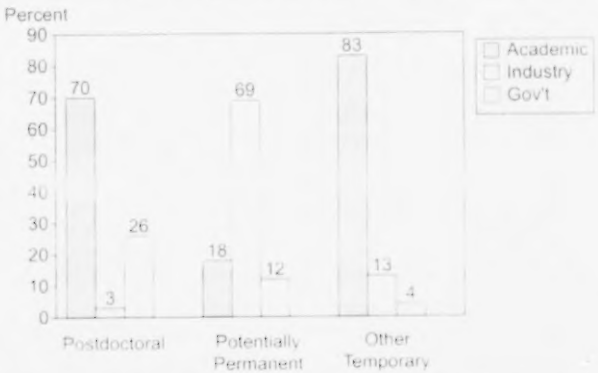
As has been historically true, almost all postdocs are employed in academic and governmental sectors (**See figure 4**). However, in recent years there has been a shift in employment sectors for those accepting potentially permanent positions. In the late 1980's about 40-50% of the new degree recipients accepting potentially permanent positions were employed by the industrial sector. A decade later that proportion has now risen to around 70%. This reflects both an increase in the number of employers seeking physics PhDs and an increase in the number of PhDs opting for employment in the private sector.

The majority of new physics PhDs accepting temporary positions other than postdocs are employed in academia. They hold a variety of positions including lecturer, visiting professor and research scientist.

Figure 4. Employment sector and type of position secured by physics PhDs in the winter following their degree, class of 1997-98.



Percent totals by type of employment may not add to 100% because military and non-profit organizations are not included.

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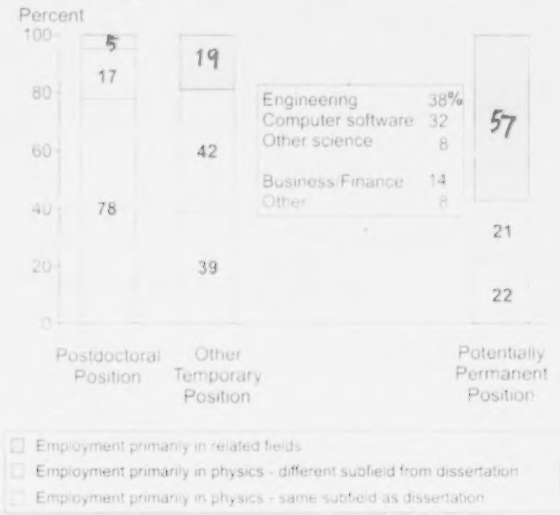
Figure 5. Field of employment and type of position secured by physics PhDs in the winter following their degree, class of 1997-98.



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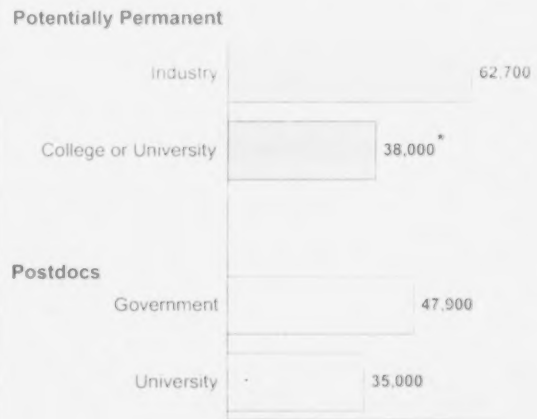
As in the past, the vast majority of the individuals accepting postdoctoral positions remain not only in the field of physics but specifically within their field of doctoral specialization (**See Figure 5**). The most common reported postdoc length was two years. Many individuals indicated that they will extend or take an additional postdoc, while others will leave even before their intended postdoc term is complete.

The primary field of employment for PhDs securing potentially permanent positions is very different from those in postdocs. The majority of PhDs in permanent positions reported that they were working primarily in a field related to physics. Most of these individuals are employed within the fields of science and engineering and considered their positions to be professionally challenging and they reported using their analytical and problem solving skills.

The median annual salary for a new physics PhD is driven, to a significant extent, by the type of position and employment sector in which they find their initial employment (**See Figure 6**). The industrial and government sectors offer starting salaries substantially higher than those offered by academic institutions for either postdocs or permanent positions.

Figure 6. Median full-time annual salary and type of position secured by physics PhDs in the winter following their degree, class of 1997-98.



*Includes PhDs with salaries based on both 9-10 month and 11-12 month salary contracts at either four-year colleges or universities

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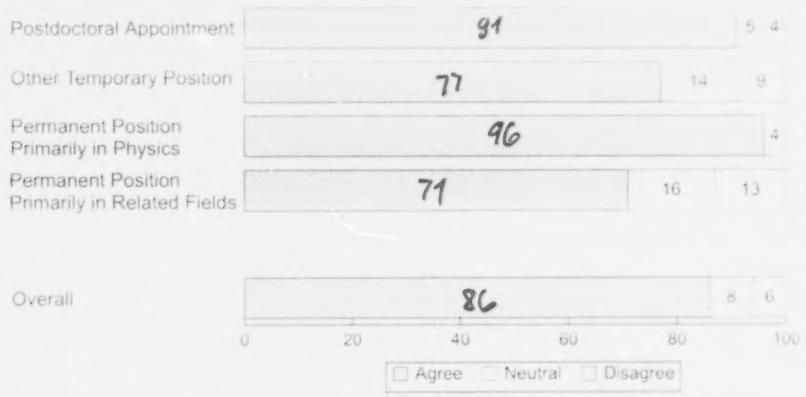
Figure 7. Ratings of professional challenge by type of US employment, physics PhD class of 1997-98.



Note: Respondents were asked to rate their agreement with the statement "My current position is professionally challenging" using a 5-point scale, where 1=Strongly Agree and 5=Strongly disagree. In the figure above, *agree* represents those respondents who chose 1 or 2 and *disagree* represents those who chose 4 or 5.

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Not only the type of position but also the specific character of the employment new physics PhDs accept is very diverse, covering a broad range of activities. This is especially true in the private sector. To get a better sense of overall satisfaction with their current position, we asked the new physics PhDs to rate their current position by responding to qualitative statements about their work. One such question explored whether they felt their position was professionally challenging. As seen in **Figure 7**, overall only a small minority of the respondents felt their positions were not professionally challenging. Another indicator of job satisfaction is whether individuals consider themselves to be underemployed. As illustrated in **Figure 8**, we see that overall, only 11% of the respondents felt they were underemployed.

Figure 8. Ratings of underemployment by type of US employment, physics PhD class of 1997-98.

Note: Respondents were asked to rate their agreement with the statement "I consider myself underemployed" using a 5-point scale, where 1=Strongly Agree and 5=Strongly disagree. In the figure above, *agree* represents those respondents who chose 1 or 2 and *disagree* represents those who chose 4 or 5.

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There were two groups of employed physics doctorates that felt less professionally challenged and more likely to consider themselves underemployed. They were the relatively small proportion of PhDs who had secured a temporary position other than a postdoc and the larger proportion with permanent jobs in a related field.

Bachelor's Degree Recipients

In the class of 1997-98 there were 3,821 physics bachelor's degrees awarded at 753 degree granting physics departments in the US. The degree class consisted of 19% women and 5% foreign citizens. (Please refer to **AIP's *Enrollments and Degrees Report*** for more detail on the characteristics of physics bachelor's degree recipients.)

Using a number of different sources, we obtained 1,130 usable survey responses from this population in the winter and spring following the academic year in which they received their degrees. These degree recipients are highly mobile and consequently difficult to track. In many instances departments do not keep accurate records of where their students go after receiving their degree. At the time of their graduation, the students themselves may not know what their address will be six months into the future.

The degree recipients were asked to make an overall assessment of their physics bachelor's degree. When asked: "If you could do it over again, would you still major in physics?", 78% of the students said they would, 14% were unsure and 8% would not. Over half of the degree recipients who said 'no' or 'unsure' were students who had directly entered the work force. The comments from the discontented students often included a wish that they had chosen a more applied field or one with a job market niche that was better defined.

As has been the case in recent years, about half of the new physics bachelors choose to continue their education at the graduate level (see **Figure 9**). Graduate studies in physics or astronomy make up more than half of this group. For students choosing to pursue graduate study in another discipline, engineering was by far the most common with 40% of them choosing that field. Degree recipients pursuing the life sciences, mathematics and the other physical sciences made up the bulk of the disciplines that the degree recipients choosing the other fields pursued.

Degree recipients in the class of 1998 who received their degrees from departments that also had a graduate program in physics were more likely to continue with graduate studies in physics or astronomy than those attending an a department that offered only a bachelor's degree in physics (see **Figure 10**). This is consistent with previous follow-up survey results. Some of this persistence stems from the kind of students attracted to various types of undergraduate programs. An AIP report on first-year graduate students shows that a larger proportion of the students who received their undergraduate physics degree at a department with a graduate program had been planning to continue with graduate school since before entering college. This is in contrast to the students coming from a department with only an undergraduate program, where a larger proportion of the students had only recently decided to pursue physics graduate studies.

Figure 9. Overall postbaccalaureate outcomes for physics bachelor's recipients as reported during the winter following their graduation, class of 1997-98.

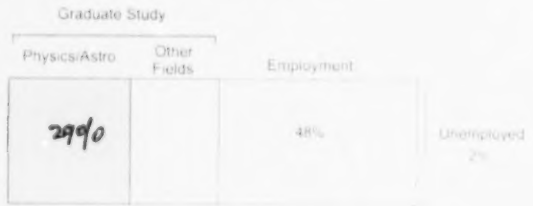

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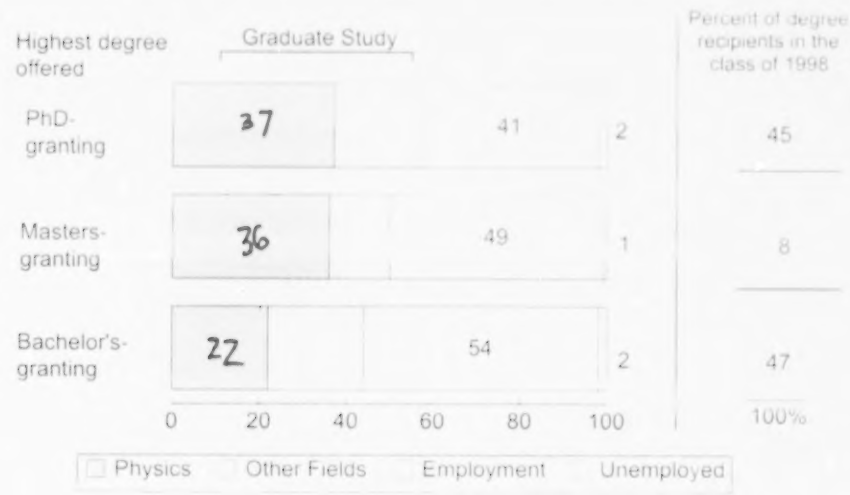
Figure 10. Postaccalaureate outcomes for physics bachelor's recipients by type of undergraduate physics departments, class of 1997-98.



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Students pursuing graduate studies in physics continue to be well supported, with only 3% of the students needing to rely upon their own funds (**See Table 1**). In contrast, almost one quarter of the physics bachelors pursuing graduate studies in engineering and nearly half pursuing other disciplines need to pay their own way. Some of this difference in funding comes from the level of graduate program in which students enrolled. The majority of the physics bachelors pursuing graduate studies in physics (73%) are enrolled in doctoral programs. For those going into other disciplines, only 29% were enrolled in doctoral programs.

As seen in figure 9 about half of the new physics bachelors in the class of 1998 entered directly into the work force. Of these, 26% indicated they had plans to return to school in the next academic year and an additional 59% planned to return after two or more years. Overall, 30% of these prospective graduate students said they planned to study physics.

A significant proportion (68%) of the newly employed physics bachelors indicated that their prior work experience was influential in obtaining their current position. Positions originating from within the department were the most frequently cited, including co-ops, internships and assistantships. Additionally, over a quarter of the respondents indicated they obtained work experience from employers not associated with the department. This occurred both while the students were actively enrolled and during their summer breaks.

Table 1. Source of financial support for bachelor's recipients continuing on to graduate study, class of 1997-98.

	Subject of Graduate Study		
	Physics	Engineering	Other
	%	%	%
Teaching Assist.	43	21	20
Research Assist.	20	37	8
Fellowship	34	15	23
Self-financed*	3	24	45
Other	-	3	4

* Self-financed includes funds from other non-department employment, family, savings and loans.

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Industry continues to be the dominant employer of new physics bachelors entering directly into the workforce (**See Figure 11**). The median salary for the 61% of the bachelors who entered the industrial sector was $40,000. This represents an increase of 8% from the previous year and over 40% from what was reported by the class of 1993-94. Becoming a high school teacher was the second most popular initial employment outcome for new physics bachelors. The salary for this group was also up, rising 13% from the previous year, to $30,000.

The work activities of new physics bachelors depend strongly on which sector they enter. As would be expected, practically all bachelors employed at elementary and high schools are teaching. Many of the individuals working in civilian government positions indicated work activities involving technical or lab related work, as well as research and development. Degree recipients accepting positions at colleges and universities indicated a variety of work activities, with many also indicating they were involved in technical or lab-related work.

Industry, by far the largest employer, hires physics bachelors into a broad spectrum of technical and non-technical positions. **Figure 12** illustrates that the majority of the industrially employed bachelors are involved in engineering related positions and those associated with computers or software.

About 1/5 of the degree recipients employed in the private sector indicated that they were working in business or finance. Not unexpectedly, when we compare these degree recipients to the rest of the industrially employed group, we find a far greater concentration of work activities involving marketing, sales and management. More surprisingly, this group also had a higher proportion of work activities involving programming or managing computer systems.

As the above findings suggest, the job market for new physics bachelors is very diverse, with degree recipients finding challenging employment in all sectors of the economy. The extent to which degree recipient feel their employment is related to the

Figure 11. Employer distribution and median salaries for full-time US employed physics bachelors, class of 1997-98.

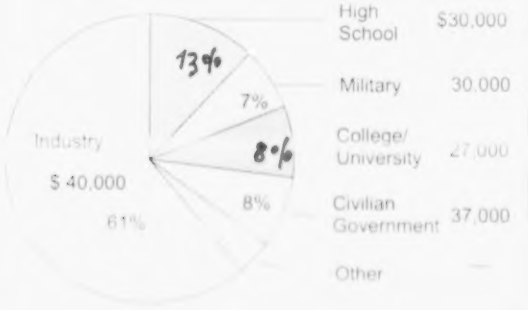

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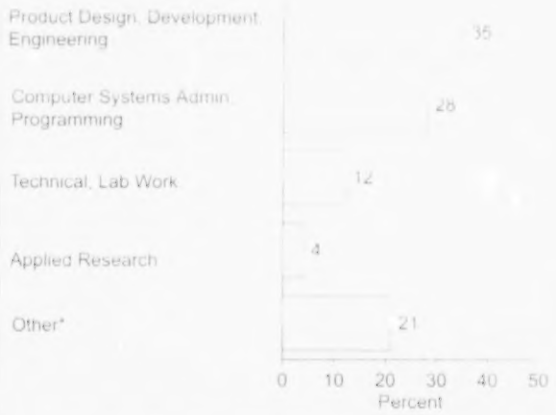
Figure 12. Primary work activity for full-time US employed physics bachelors who are working in the private sector, class of 1997-98.



* Other includes: sales, marketing, management, other professional and non-professional work.

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Figure 13. Extent to which physics bachelors felt their full-time U S employment was related to the fields of physics or astronomy, class of 1997-98.

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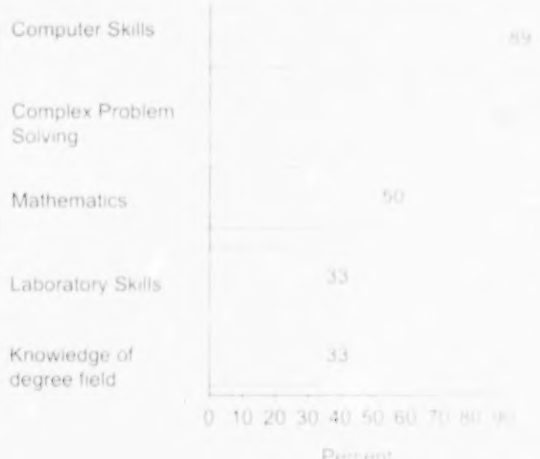
field of physics or astronomy varies greatly by the sector in which they are employed (see **Figure 13**). High school teachers had the highest proportion indicating employment in the field of physics, while those in the industrial sector had the smallest proportion.

The industrially employed physics bachelors are making substantial use of some of the skills they acquired as a result of their physics undergraduate training. As **Figure 14** shows, the vast majority of respondents indicated that they utilized their computer and problem solving skills in their current position. Only a third indicated moderate to extensive use of the laboratory and degree field skills they acquired. After combining an individual's response to the uses of skills question, only 10% of the industrially employed bachelors fell into a category that indicated their position had no technical involvement.

Master's Degree Recipients

For the class of 1998, there were 782 students exiting physics departments with a master's degree. This number is similar to the previous year and follows three years of declines. It is difficult to obtain current address information for these degree recipients, resulting in a low number of respondents. Consequently, the following data for physics masters reflects the combined survey responses from the classes of 1997 and 1998. The data reported come from 346 individuals in the combined classes totaling 1,571 degree recipients. Even with the combined survey responses, the low

Figure 14. Extent to which industrially employed physics bachelors felt they made moderate or extensive use of selected skills that they acquired while an undergraduate, class of 1997-98.



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response rate should be taken into account when interpreting the results reported below. These data do not include students who received a master's degree enroute to a physics doctorate at the same department.

According to the Enrollments and Degrees Survey, the combined classes of 1997 and 1998 masters included 19% women and 38% foreign citizens. Two-thirds of these exiting master's degrees came from departments that also offer a doctoral level physics degree.

The post-degree outcomes for the combined 1997 and 1998 physics master's classes are shown in **Table 2**. Overall, a little more than half of the respondents indicated that they entered directly into the work force. A quarter continued with physics graduate studies, 16% pursued graduate study in a subject other than physics, and 5% were unemployed. Of the employed physics masters, 41% planned to return to graduate school in the future, with physics being the most popular choice for a future subject. Half of the degree recipients pursuing graduate studies in a subject other than physics were enrolled in an engineering program. The foreign master's degree recipients were more than twice as likely than their US counterparts to pursue graduate studies.

Table 2. Post-degree outcomes of physics Master's degree recipients by citizenship, classes of 1997 and 1998.

	Citizenship		
	US	Foreign	All
	%	%	%
Physics graduate study*	20	42	25
Graduate study in another field	12	30	16
Employed	62	24	54
Unemployed	6	4	5
	100%	100%	100%

* At a different university than which they received their masters.

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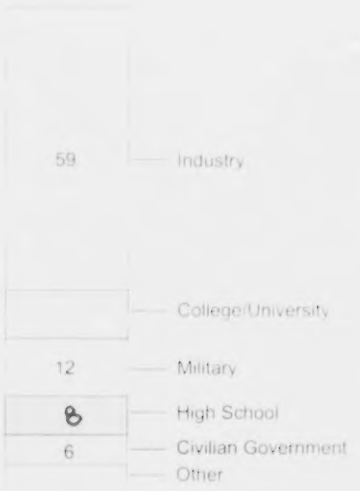
Figure 15. Employer distribution of full-time US employed physics masters, classes of 1997 and 1998.



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Industry is the largest employer of new physics masters (see **Figure 15**). About two-thirds of these industrially employed masters indicated their positions were moderately or extensively related to the field of physics. Their work activities centered around product design development and engineering, followed by programming and computer system administration. The median annual salary for masters working in industry was $45,400.

The master's degree recipients, similar to the physics bachelors, were asked if they would still major in physics if they had an opportunity to do it over again. Approximately one-fifth of the respondents indicated that they would not. These non-affirmative answers were more likely to come from foreign rather than the US degree recipients. When asked why, many of the responses indicated dissatisfaction with career and employment prospects.

Astronomy

For the 1997-98 academic year, the AIP survey of Enrollments and Degrees gathered degree recipient totals from the 69 degree-granting astronomy departments in the US. About half of these departments are combined with a physics department at the same university, and half are administered separately. The data presented here do not include astrophysics students who got their degree from a department of physics. They were included in the earlier discussions addressing physics PhDs. There were 116 PhDs, 25 exiting master's degrees and 192 bachelor's degrees conferred at these 69 astronomy departments during the 1997-98 academic year. The PhD recipients included 19% women and 34% foreign citizens. Among the astronomy bachelors, 33% were women and only 4% were foreign citizens.

This year's data show an increase in the proportion of new astronomy doctorates accepting postdoctoral appointments. For the class of 1998, 76% of the responding PhDs indicated that their initial employment position was a postdoc (see **Figure 16**), this is up about 14% from the number taking postdocs in recent years. This figure excludes the 15% of astronomy PhDs who indicated they were working abroad. The median annual salary reported by individuals in postdoctoral appointments at a university was $36,000.

The initial post-degree outcomes for responding astronomy bachelors in the class of 1998 are shown in **Figure 17**. Overall, 40% of the new degree recipients choose to continue with graduate studies, the majority in astronomy or astrophysics. These graduate students, regardless of discipline, indicated they were enrolled on a full-time basis and were receiving support in the form of a fellowship or assistantship.

As in the past, the dominant employment sector for the astronomy bachelors entering the work force was industry, with engineering-related work being most frequently cited.

Overall, the majority (87%) of astronomy bachelors indicated they would major in astronomy again if given the opportunity. All degree recipients that entered graduate school felt their undergraduate studies had adequately prepared them for further schooling.

Figure 16. Type of US employment secured by astronomy PhD's, class of 1997-98.

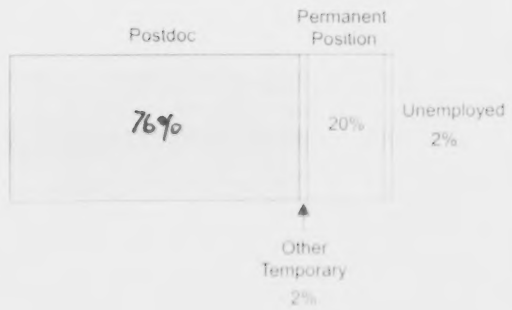

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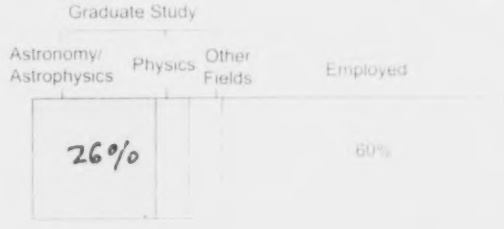
Figure 17. Post-degree outcomes for astronomy bachelor's degree recipients, class of 1997-98.



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